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No. 801.

CAR TRACKS AND PAVEMENTS.

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WITH DISCUSSION.*

The present enormous development of transit facilities in the streets of urban and suburban communities, and the desire for immediate results rather than for permanent construction, have already led to complications and problems which demand the careful study of the engineering profession, and to which more particular attention in the future will have to be given.

In the construction and maintenance of streets and highways, certain principles and practices have been formulated, and by selection accepted as giving the best results, economically, for the particular travel they have to endure. In the maintenance of railroad tracks, the practice has been more crystallized, and a standard has been adopted from which only the lack of means excuses a departure.

These practices exercised separately offer no field of discussion, but as soon as the maintenance of track and that of pavement are united

* The discussion on Papers Nos. 801 and 802 was a joint one, and will be found on pages 78 to 132.

in one street or in one city, then the relations of the two interests become complex, and the economic adjustment of the differences between the parties interested opens up a wide field of discussion, in what may be called, at present, at least, an undeveloped territory, and in which, therefore, it may not be considered improper to inject a few suggestions.

The first point to be considered is the relation of the owner of the railway to the authorities in charge of the highway, and involves so far three situations :

First.—Where the municipality owns both track and street.

Second.—Where the company operating the railroad assumes as part of its franchise the care of the pavement in the street.

Third.—Where the municipality cares for the pavement outside the tracks, and the company cares for the track and the pavement between the rails.

While the first two conditions actually exist, they are so rare in this country that much consideration cannot be given to them, except as to formulate what, in some minds, might be called the ideal. They have only been adopted in isolated cases, under peculiar conditions, and do not seem to commend themselves generally to municipalities or capitalists.

It will not be out of order, however, to allude to two or three ideas that suggest themselves on these two heads. It would be of undoubted advantage to have the control of track and pavement vested in one authority, as more economic results can be obtained, and the riding public and driving public would both be placed on a fairly equal basis; but the general unsatisfactory administration of municipal affairs at this time places a great barrier against municipal control. On the other hand when the railroad company assumes control of the whole pavement of the street, the company, as a money-making institution, would not have as high an idea of the character of a good pavement as the critical taxpayers would demand, and when repairs are numerous and costly, they may not be made with the alacrity that a high citizenship would suggest.

Another condition of things might exist where the municipality keeps the whole pavement in repair, and collects from the company the cost of the latter's part between the tracks. This might work satisfactorily if one point did not come up to create trouble; it is the

one point that is going to make endless friction and is the unconsidered element, viz., the repairing and renewing of the track itself.

Assuming, then, that the existing condition, and for a while the future condition, is the separation of the control of the pavement from the control of the track, it will be in order to consider the relations thereto in a purely engineering sense, and from this consideration certain governing principles which may be of benefit to both parties concerned. As a basis for these relations it will be proper also to assume that the workmanship of both pavement and track are perfect, considering that any departure from this standard of perfection would only aggravate the difficulties.

The construction and operation of a horse railroad on a street or highway, while to a certain extent separating the vehicular travel from the track itself to the area left on either side or between the rails, does not by any means isolate it; it is a matter of history that rails were especially designed to keep the wagon travel away from the car tracks, and it may be fairly assumed that the car travel was a component part of the general travel. With the introduction, however, of a higher rate of speed, either by cable or electricity, the result has been, first, to increase enormously the travel on the cars, so much so that in many cities the main car lines have practically driven away the wheel travel, and, second, the wheel travel has been forced into the two driveways and only in an emergency is the car track space used.

The result to the pavements on the streets is that the travel on them is localized into two narrow lines on which the wear is peculiarly excessive, leaving the space between the tracks rarely used. To compensate this to a certain extent is the fact that rapid surface street transit has decreased to a large extent horse travel, and also has driven a portion of the said travel on to other streets. The effect of this localization of travel on parallel lines to the track is to induce excessive wear in certain spots, and but little in others. The sequence to this, of course, is more frequent renewals in pavements, to preserve uniformity.

It is not in the scope of these remarks to allude to the merits and demerits of any particular pavement; but, to appreciate the situation properly, the accepted standard pavements now in use should be stated, and they are granite block, asphalt, brick, telford and macadam. The various cities in the country have or are making experimental de-

partures into other classes, but the list given above can be considered unchallenged. Of the pavements mentioned, the accepted practice is to lay the first three on a bed of concrete, and in many cases this concrete is continued between the tracks, and in it the ties are imbedded. In the telford and macadam streets, the spaces between the tracks are paved with block, with an edging of block outside the rails to keep the broken stone surfacing away from the rails.

Into these pavements are injected the car tracks, with, as a rule, small ties laid far apart on the bare ground, with a heavy girder rail spiked to them, and tie-rods every few feet. On track of this character loads are carried practically equal to those on steam railroads. The practice of maintenance of track on steam railroads is so matured that allusion to it here would be superfluous, but it is safe to say that every salient requirement of steam railroad track work, except the rails themselves, has been carefully ignored in street railroad track. This is due, as far as the author's observation goes, to these causes—extreme haste in the construction of the work, lack of appreciation of the future use and requirements of the road, and, probably, to lack of funds also.

This situation is, then, to be faced—a carefully laid pavement, designed with one object particularly, viz., permanency; intermingled with it is a perishable construction requiring repairs, incessant and immediate. A prominent street railroad superintendent is credited with the statement that every street railroad track will on an average have to be renewed every ten years. While this statement may be criticized, there is good reason to believe in its accuracy.

Assuming for argument that the ten-year period is correct, the fact that every square yard of pavement within the limits of the track and also to the outer edge of the tie will have to be torn up and relaid every ten years opens up a field of speculation as to the proper practice to be adopted, both for tracks and pavement, in the future, to preserve an ideal in both cases.

Taking the case of a block pavement laid on a concrete bed, with every tie imbedded in the concrete, the actual cost of removing the material is a large item. Relaying is costly, and will sufficient care and watchfulness be given to insure a homogeneous structure afterward? Experience is apt to point otherwise. If concrete is not used between the tracks, the pavement itself will not be permanent and will

require continuous repairs to keep it up to standard, and this standard will be achieved only with great difficulty. This same argument will apply both to asphalt and brick. In the last year, more attention has been given to this question of permanency in tracks, and the use of 60-ft. rails and welded joints is to be greatly commended; but a track spiked to wooden ties laid on soft earth can never be deemed permanent, and the adoption of a track laid in concrete itself is a matter to be considered carefully. There have been for years earnest advocates of this method, and patents have been granted for such practice; but, so far, it has never commended itself strongly to that branch of the profession. It can be readily seen that rails with welded joints, firmly laid in concrete, and superimposed on this a pavement also laid in concrete, would be the desideratum, provided it can be proved that such construction of itself is inherently correct.

The substitution of steel ties for wood, laid in concrete, also suggests itself, and it would be futile to go into the region of speculation; but it is proper to insist, that a practically permanent track is to be desired, on the part of the public, for the good condition of the pavements. It must be also desired by the operating company on the score of economy; and, with a common end in view, it is natural to assume that before long both parties interested will work together.

The foregoing remarks apply to streets of cities, where there is a systematic practice of having good pavements, and with a corresponding desire to keep them so. In others, where there is indifference and even negligence on the subject, the railroad companies, as a business operation, will keep their tracks in fair condition, but the streets themselves will become practically useless for traveling.

In the relation of pavements to tracks in suburban and rural sections, the problem encountered is different in character, but none the less complex, and as the future of electric propulsion will be largely in that direction, a few ideas on that question will not be amiss.

The elimination of the idea of permanency as demanded for city work will first occur. No country highway, whether of earth, gravel, macadam or telford, is designed to give a permanent surface. The theory of use demands constant and incessant renewals in the surface, and breaking up and relaying the pavements themselves need not inflict permanent injury to them. So both track and roadway can be considered purely in their economic view.

If the present practice of wooden ties be found to be the most economical, let them be laid so, even if track surfacing be constantly necessary. The only point to be insisted on is that whatever road material is taken up should be carefully relaid and cared for afterward, to obviate settlement and unevenness.

In laying tracks on suburban and country highways, a few ideas which suggest themselves may be noted. The original tracks for horse cars were paved, as a rule, with cobble stones. Theoretically, it gave a better footing for the horses. On the substitution of electric tracks, the original cobble stones were relaid without forethought. This practice, of course, was not long tolerated, and Belgian block was substituted. It was found, however, that, except in very narrow roads, no travel ever came on the pavement except to cross it, and telford or macadam pavements were laid in the tracks, with an edging of trap rock block against the rails. Experience showed that blocks did not wear, and the macadam did. The result was that in a short time the blocks projected 1 or 2 ins. above the macadam. The later practice is now to leave out the edging and use macadam entirely. This, of course, is not applicable to steep grades, as the macadam will wash out in heavy rains from the concentration of the flow by the rails.

One serious difficulty encountered in the maintenance of macadam roads along rail tracks is the localization of travel in two parallel lines about 2 to 3 ft. from the outside rail, and it is found that the cost of repairs for the same distance is practically doubled, as telford roads originally requiring attention once in two or three years now have to be patched every year, and then with less satisfactory results.

One curious trouble found in laying the block edging against the rail on telford roads was that the sand designed to support the blocks was washed by the rains into the interstices of the foundations, letting the blocks down. Very coarse gravel and cinders used as a substitute for the sand removed the difficulty.

The concentration of travel into the parallel lines quickly caused ruts to be made, a very unusual experience to the author, and the solution of the difficulty has not yet been arrived at. Broken stone of larger size, up to 3 ins., is now being tried, and, so far, is an improvement, but the surface is rougher. This trouble, of course, only occurs when the tracks are in the center, and the driveways on the side. This brings up the question of the location of the tracks, and in

that the practice is varied. In cities as a rule the center is the only available place, and opinion is well crystallized in favor of that location; but in suburban roads the practice is varied.

On a 50-ft. roadway, a 20-ft. driveway in the center, a track on each side, and then 9 ft. for access to houses, gives good satisfaction, preserves the driveway, and lessens repairs. In a 60-ft. roadway and 14-ft. driveway outside the tracks, all the requirements are attained. In a roadway of less than 50 ft., the tracks of necessity must be in the center. Where only one track is laid on a country road, the track should be on one side, with switches towards the center.

The ideal road with trolley tracks is probably the extension of Beacon Street, Brookline, Mass. One wide roadway in the center, the trolley tracks sodded with grass, and a driveway on each side for local access give all the necessary facilities for the varying wants of the traveling public.

In the construction of Beacon Street, the company which owned the land opened the street, graded it, and was in sympathy, if not identical, with the trolley company. The result was perfection; but when a trolley company, the municipality and the property-owners are pulling in different directions, the doctrine of perfection is difficult to inculcate.

With the unexpected and enormous increase of travel on street railways due to low fares and increased speed, and a general appreciation of the profits derived therefrom, the public has gradually increased its demands upon the traction companies for the privileges conferred. The newness of the plants has so far rendered renewals unnecessary, and repairs and the cost of such repairs have not yet been fully appreciated; so that whether the companies will concede more to the communities, or will do less in the future, cannot be fully predicted. Until then, no permanent status of their relations can be fixed.

However, with the constantly increasing demand and insistence upon good pavements and highways, the practice, both of track and street maintenance, is bound to receive the thought and consideration of professional men, and if these few remarks shall be conducive only to that end, they will not be in vain.